

A NEW *DONDICE* (OPISTHOBRANCHIA: FAVORINIDAE),
PREDATOR OF *CASSIOPEA* IN SOUTHWEST
PUERTO RICO

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ABSTRACT

A new species of eolid nudibranch, *Dondice parguerensis*, is described from La Parguera, Puerto Rico. Major diagnostic features of the species include nine groups of cerata on either side; genital pores between the first and second groups of cerata; rhinophores with up to 11 annulations; masticatory process with about 54 denticles and about 20 radular teeth, with 7 denticles per side.

This is the first report of the predatory association between the new species and the scyphozoan *Cassiopea*. The principal host is *C. xamachana*, although *C. frondosa* can also be its host. The nudibranch feeds on the finer parts of the medusa's oral arms, on which it also lays its eggs. Like all other cnidarian-feeding eolids, *Dondice parguerensis* stores the nematocysts of its host, and the larger euryteles are selected in a ratio of 5 to 1.

At peak abundance during the months of November to February the eolid can be found on up to 80% (average 45%) of *C. xamachana*, and the average rate of infection is 2.3 nudibranchs per medusa. The nudibranch exhibits an aggregated distribution on the jellyfish.

D. parguerensis has a life span of approximately 9 weeks. Newly laid eggs hatch in 2 to 6 days, and development is planktotrophic. Veligers apparently settle upon the scyphozoan, and rapid growth takes place after metamorphosis. Nudibranchs and their egg masses can be found year-round on *Cassiopea*.

In the vicinity of La Parguera, Puerto Rico an undescribed species of *Dondice* lives, feeds and breeds upon the oral arms of the scyphozoan medusa *Cassiopea*. The mollusc, never found apart from *Cassiopea*, has planktotrophic larvae and settlement is apparently directly upon the medusa. An association of this intimacy is essentially parasitism. Previously reported associations of eolids with scyphozoans are limited to the following instances of predation: *Cratena pilata* (Gould, 1870) upon the polyps of *Chrysaora quinquecirrha* (Desor, 1848) in Chesapeake Bay (Schultz and Cargo, 1971); *Facelina auriculata* (Alder and Hancock, 1855) on *Lucernaria auriculata* (Muller, 1776) (Swennen, 1961); *Austraeolis catina* (Marcus, 1962) occasionally upon *Cassiopea* in Florida (Clark and Goetzfried, 1978); and *Coryphella verrucosa* (Sars, 1829) on *Lucernaria* spp. (Day and Harris, 1978).

Dondice E. Marcus, 1958

Facalaninae with simple jaws, produced foot corners, unarmed penis, separate prostate gland and a penial gland. Type species by original designation *Caloria occidentalis* Engel (1925: 73).

Dondice parguerensis new species

Diagnosis.—Cerata in up to nine groups per side, first three arranged in horseshoe pattern; genital pores between the first and second groups of cerata, anterior to pericardial hump; distal portion of rhinophores with up to 11 annulations; masticatory process with about 54 denticles; radular teeth about 20, with 7 denticles per side.

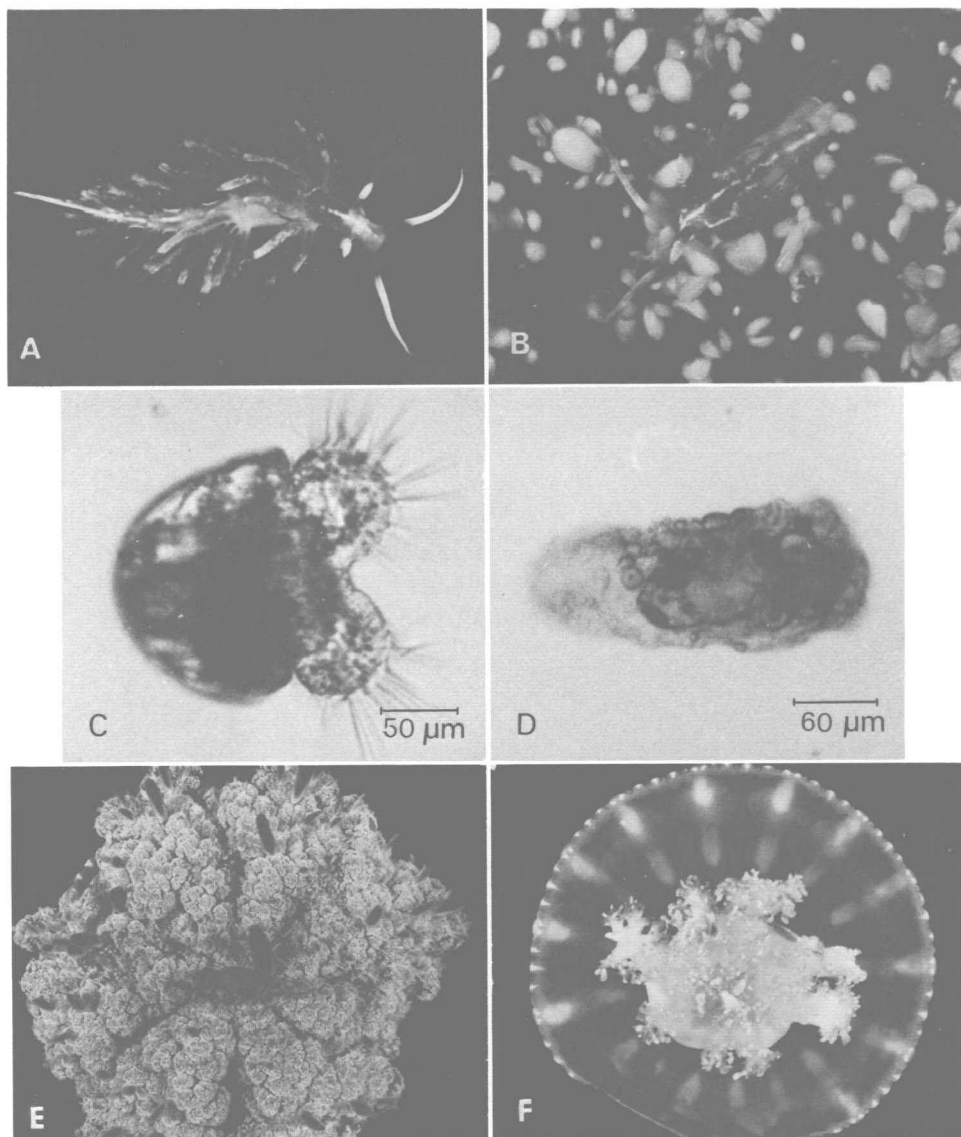


Figure 1. *Dondice parguerensis* new species. A, adult; B, adult on *Cassiopea xamachana*; C, 3-day-old swimming veliger; D, metamorphosed larva 13 days old; E, healthy 150-mm diameter *Cassiopea*; F, same medusa a week later after being parasitized by five nudibranchs.

Material Examined.—A total of 450 specimens were collected from *Cassiopea* on the lee side of several reefs off La Parguera, Puerto Rico between December 1979 and September 1982. Of these, specimens were chosen for sectioning, dissecting and preserving, and remaining specimens were used alive for measurements, description, breeding stock and behavioral observations. The holotype (USNM 835117) and paratypes (USNM 835118 & 835119) were collected from Cayo Collado, 1.2 km W of La Parguera (Latitude 17°57.4'N, Longitude 67°04.7'W), 7 January 1981.

Size.—All measurements are in millimeters and are from the largest living, fully extended animal measured: length 48; width at pericardial hump up to 7; longest tentacle 10; longest rhinophore 7; longest ceratum 7.5.

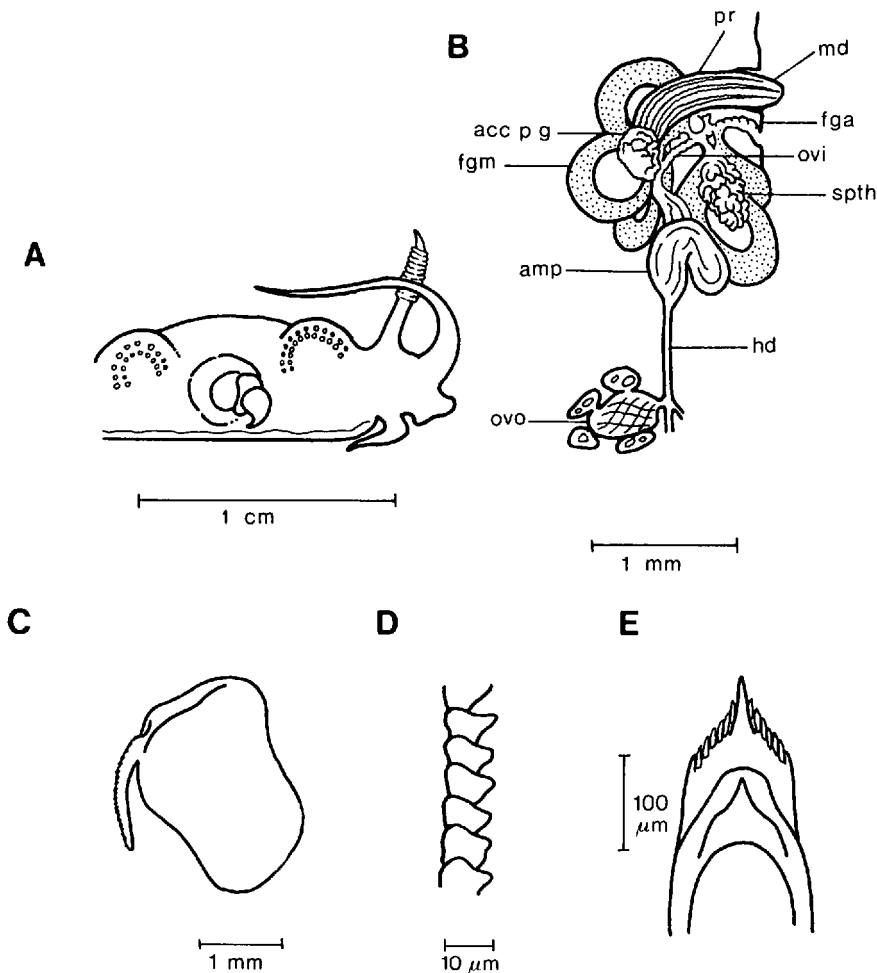


Figure 2. *Dondice parguerensis* new species. A, lateral view of anterior end with right ceratum omitted, showing anus, penis and female gonopore; B, diagram of the reproductive system; C, jaw; D, denticles on masticatory border of jaw; E, eighth tooth from an animal with 16 radular teeth. Abbreviations: acc p g, accessory penial gland; amp, ampulla; f g a, female atrium; f g m, female gland mass; hd, hermaphroditic duct; md, male duct; ovi, oviduct; ovo, ovotestis; pr, prostate; spth, spermatheca.

Number and distribution of cerata on a 37-mm specimen

	Anterior liver				Posterior liver				
Right side	26	21	18	14	11	9	8	3	1
Left side	21	20	17	13	10	8	8	2	1

Description.—Slender body broadest in region of pericardial hump, then tapers gradually to long tail; tail slender, pointed and approximately one-fourth body length; anterior-lateral margins of foot form pronounced foot corners, and sole of foot wider than body. Cerata arise from up to nine low ridges on each side. First three ridges horseshoe-shaped, more posterior short and transverse; only last few ridges have less than two rows of cerata; cerata long and finger-like with

terminal cnidosacs. Tubular digestive diverticula visible through ceratal wall; first and second groups of cerata widely separated by pericardial hump; dorsal cerata of these groups are longest and usually longer than rhinophores; about 250 cerata present on a 48-mm animal.

Cephalic tentacles slender and pointed; rhinophores slightly shorter and thicker than tentacles; distal third of rhinophore has up to 11 annulations. Genital pores located on right side of pericardial hump, between first and second arches of cerata. Anus opens under first arch of right posterior liver and renal pore is interhepatic (Fig. 2A).

Living slugs largely translucent ochre. Tips of tentacles, rhinophores, cerata, foot corners, as well as prominent dorsal stripe white; digestive diverticula in cerata generally darker brown-ochre in freshly fed slugs; median dorsal stripe extends from anterior border of mouth back to tail. There may be a white lateral stripe running from underneath base of rhinophore back to last group of cerata, broadening at bases of cerata. Most slugs have grayish-white cheek patches, and some have slender, transverse white bars behind eyes that extend half-way down side of head of animal. Cerata also bear white rings just below cnidosacs; brown pigment may be present in epithelium covering jaws and can be seen through skin; sole of foot off-white.

Jaws delicate, fragile and light yellow in color (Fig. 2C) with conspicuous dorsal indentation and pronounced anterior part to which masticatory process attached. Masticatory process bears over 50 pointed denticles, of which first dozen or so blunter than others; denticles measure up to 10 μm (Fig. 2D). Up to 20 (16 average) teeth make up uniseriate radula; pronounced median cusp surrounded by seven smaller denticles on either side (Fig. 2E). In a radula of 14 teeth, the middle tooth was 145 μm broad and 215 μm long.

Ovotestis consists of large male follicles and numerous female acini (Fig. 2B). Hermaphroditic duct expands to long, curved ampulla that continues on as short, narrowed spermoviduct that bifurcates into male duct and oviduct; male duct passes through center of muscular penis papilla, which appears to be slightly triangular in cross-section; papilla protrudes from small male atrium or enclosed within it. Tubular prostate gland runs alongside male duct through penis and opens independently of vas deferens; another duct, that of an accessory penial gland, also accompanies male duct through penis papilla; gland located dorsal and posterior to base of penis; penis unarmed.

Oviduct wide, muscular and ciliated, canal opening into female atrium. Spermatheca, tubular sac, connected very near junction of oviduct and vagina; convoluted, folded female gland mass connects to female atrium by several nidal openings.

Habitat and Biology.—Adult *Dondice parguerensis* from 20 to 48 mm in length can be found year-round living on *Cassiopea frondosa* and *C. xamachana*, preferring the latter, in quiet waters up to 8 m in depth on the lee sides of reef flats off the southwest coast of Puerto Rico. Thus far the nudibranch has not been found apart from the jellyfish. Based on the evidence gathered during this study, *Dondice parguerensis* can best be described as being a parasite of *Cassiopea* as most, if not all, of its life cycle is spent on the jellyfish. Due to its cryptic coloration the slug is very hard to notice in the field. The nudibranchs were most abundant during the months of September to February. Percentages of juveniles (length 20 mm or less) were highest during the months of November to March 1982, fluctuating between 50% and 75%. Neither the juveniles nor the adult nudibranchs were evenly distributed over the populations of *Cassiopea xamachana*. In the

months when most abundant, nudibranchs outnumbered the jellyfish sampled, yet they were found on only 27–80% of them. Thus, if one nudibranch was present, chances were good that there were more. On the infested *Cassiopea*, up to four slugs per medusa were not uncommon, and as many as 11 (average 2.3) nudibranchs per medusa were recorded. The nudibranchs exhibited aggregated or clumped distribution on the jellyfish.

Dondice parguerensis feeds voraciously and most of the time. In less than a week five slugs entirely devoured the small oral arm appendages of a 150 mm diameter jellyfish (Fig. 1E and F). Normally, grazed areas are regenerated by the medusa at about the same rate they are cropped.

The brown color of the slugs' liver diverticula is derived from zooxanthellae obtained from *Cassiopea*. Holotrich and eurytele nematocysts from the jellyfish are contained in the cnidosacs; larger euryteles outnumber holotrichs about 5 to 1. The fact that many more euryteles are present strongly suggests nematocyst selection by *Dondice parguerensis*. The stored nematocysts are utilized by the eolids for defense and are discharged when the nudibranch reacts violently to rough handling or prodding. The fish *Gerres cinereus* (Albaum, 1792) immediately spat out a *Dondice* it had grabbed.

When collected into plastic bags, the slugs give off a transparent mucus with a "milky" odor. *Dondice parguerensis* are visibly affected if they remain for long periods of time in a bag with *Cassiopea*. Most lose cerata and remain inactive, while small ones die.

Dondice parguerensis begins spawning at 20 mm length. In histological sections of several juveniles well developed testes and a few immature ova were present. Larger animals have more ova in relation to testes. Spherical eggs averaging 125 μm (capsule diameter) are laid in randomly folded gelatinous strings which are usually entangled among the oral arms of *Cassiopea*. Egg masses are 0.6 mm in diameter and up to 210 mm long. A single egg mass contains approximately 34,000 ova. Adult slugs spawn virtually continuously for 6 weeks before dying.

Fresh laid eggs hatch in 2 to 6 days into veligers ranging in size from 150 to 200 μm in diameter. The planktotrophic veligers begin to feed on micro-algae soon after hatching (Fig. 1C). None have lived in the laboratory for more than 25 days; however, two of the veligers underwent metamorphosis after 13 days but died shortly afterwards (Fig. 1D). Settlement apparently occurs on the medusa, for very small (2 mm) post-metamorphic juveniles were collected from *Cassiopea*. Rapid growth takes place after metamorphosis. Individuals 2 mm long reached adult size in less than two weeks. The life cycle, though not completed, can be roughly estimated as 9 weeks.

Discussion.—Marcus (1958) erected the genus *Dondice*, placed five species in it and suggested that two others might also belong. Edmunds (1964) stated that the classification of the family was in an unsatisfactory state and stressed the fact that the presence of the penial gland and a separate prostate as well as penial armature were equally important generic characters. He referred the two species *Dondice banyulensis* (Portmann and Sandmeier, 1960) and *D. horridus* (Macnae, 1954) to the genus *Godiva*.

Other species of *Dondice* are clearly distinct from *Dondice parguerensis*. *Dondice modesta* (Bergh, 1881) and *D. ceylonica* (Farran, 1905) have smooth rhinophores; in *D. veranyana* (Bergh, 1875) only the right and left anterior livers are horseshoe-shaped, and the radular tooth is a much broader arch than in *Dondice parguerensis*. Very little is known about the male genital systems of *D. modesta*

and *D. veranyana*, making comparison of characters other than lack of penial armature impossible.

Dondice occidentalis (Engel, 1925) is most similar to *Dondice parguerensis* but differs in the following respects. *D. occidentalis* has six groups of cerata instead of nine, and the gonopores are located underneath the first rather than between the first and second arches of the cerata. *D. occidentalis* reaches a length of 30 mm as opposed to 48 mm in *Dondice parguerensis* and has a median red stripe along the head and lateral stripes of the same color running back to the tail. *D. parguerensis* never has any red markings. The epithelium that covers the jaws of *D. occidentalis* and is visible externally because it is black (Edmunds, 1964) is present in *D. parguerensis* although not black in color. *Dondice parguerensis* lives and feeds only on *Cassiopea* while *D. occidentalis* feeds on the hydroids *Eudendrium* and *Zoobotryon* (Marcus, 1958). Larvae of *D. parguerensis* are planktonic and hatch when 100–200 μm long while larvae of *D. occidentalis* are lecithotrophic and hatch at 97 μm .

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